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HUMAN CAPITAL, EMPLOYMENT PROTECTION AND GROWTH IN EUROPE

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Human Capital, Employment Protection and Growth in Europe*

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Abstract

Using data for 51 manufacturing and service sectors for the period 1970-2005 in 14 EU countries, this paper shows that employment protection legislation has a negative and significant effect on growth of value added and hours of work in more human capital intensive sectors. We argue that labour market regulation has a negative impact on the technology adoption mechanism through its heterogeneous impact on firms' workforce adjustment requirements. In fact, technology adoption depends both on the skill level of the workforce and the capacity of firms to optimally adjust their employment levels as technology changes. As a consequence, firing costs have a relatively stronger impact in sectors in which technology adoption is more important. Our empirical results are robust to various sensitivity checks such as interactions of human capital intensity with other country level variables, of employment protection with other sector level variables and endogeneity of firing restrictions. We also show that the negative effect of EPL is stronger the smaller the distance from the technology frontier and after the 1990s.

Keywords: Growth, Human Capital, Technology Adoption, Employment Protection Legislation, Sectors.

JEL Classification: J24, J65, O47, O52.

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1 Introduction

Do labour market institutions affect economic growth in the long run? If that is the case, which are the channels through which labour regulation affects growth? How important are labour market institutions for the adoption of new technologies? Are these effects differentiated across industries? In this paper we try to answer the above questions by looking at the quantitative effect of employment protection legislation (EPL) on growth of value added and hours of work across sectors in Europe during the period 1970-2005. We do this by investigating the heterogeneous effects on industry growth of the interaction between a country's level of EPL and a sectoral measure of technology adoption intensity.[1]

In a recent paper, Ciccone and Papaioannou (2009) show that countries specialising in sectors with higher human capital intensity are those with higher levels of schooling. The complementarity between a country's level of schooling and sectoral human capital intensity, defined as the average schooling level of employees in each sector, fosters growth particularly in human capital intensive industries through a technology adoption mechanism (as in Nelson and Phelps, 1966). Such mechanism is also confirmed by abundant empirical evidence on the positive correlation between human capital and technology adoption: Doms et al. (1997) show that plants that use more advanced technologies employ more skilled and educated workers; Berman et al. (1994) and Autor et al. (2003) also find a positive correlation between the level of investment in technology in an industry and changes in workers' skills; Machin and Van Reenen (1998) offer evidence of significant complementarity between technology and human capital across OECD countries; while Caselli and Coleman (2001) suggest that adoption of new technologies is positively related to higher levels of human capital endowments.[2]

The above literature suggests that the presence of a highly skilled workforce is crucial for the successful adoption of new technologies, such as automated machinery and information and communication technologies.[3] However, the technology adoption process depends not only on the skill level of the workforce in a particular sector, but also upon the capacity of firms active in that sector to optimally adjust their employment levels as technology changes (Samaniego, 2006). If sectors experience different rates of technical change, firms operating in different sectors have heterogenous paths of adjustment of employment: in particular, the faster the rate of technical change, the higher the requirements for cutting or upgrading the workforce.[4] Hence, firing costs may have a relatively stronger impact in those sectors

[1]By technology adoption we mean the capacity to fully exploit the potential of recently developed technologies, and not simply imitate well established ones. Leading examples are automated machineries and information and communication technologies, whose productivity potential is fully exploited by highly skilled workers.

[2]More recently, Lewis (2010) shows that the skill composition of employed workers is positively associated to the adoption of automated machinery in manufacturing, while Bartel et al. (2007) find that the presence of information technologies enhancing equipment is positively associated with skill requirements of the workforce. Finally, Bresnahan et al. (2002) identify a positive correlation between IT, decentralised workplace organisation and human capital.

[3]There is also some mild empirical evidence on a positive relationship between total factor productivity growth and human capital intensity: while Klenow (1998) does not find a positive relation for the US, Griffith et al. (2004) present instead some favourable evidence that higher human capital intensity tends to increase TFP growth in a panel of industries for a set of OECD countries; Khan and Lim (1998) find a positive link between an industry share of high skilled labour and its TFP growth for US manufacturing sectors for the 1970s and 1980s; in turn, O'Mahoney et al. (2009) show that TFP growth is higher for firms operating in high skill industries.

[4]Michelacci and Lopez-Salido (2007) find that technological advances increase job destruction and job reallocation while Antelius and Lundberg (2003) offer some evidence that the rate of job turnover is higher in

in which technical change is faster as they reduce the expected returns on adopting new technologies. As a result, EPL could negatively affect the specialisation pattern of countries by slowing down growth particularly in sectors with rapid technical change, such as human capital intensive sectors, in which technology adoption is more important. This channel is strictly related to the mechanism identified by Saint-Paul (1997) to understand the effects of EPL on the pattern of international specialisation: in his theoretical framework, countries with higher levels of EPL tend to specialise in less innovative sectors to avoid additional firing costs that are more likely to arise in sectors characterised by more drastic innovation. The link between labour market institutions, technology choice and economic performance has also been theoretically investigated in a recent paper by Poschke (2010) where the author presents a dynamic stochastic model of heterogeneus firms with technology adoption and entry costs. The calibration exercise presented in the paper shows both that small entry costs reduce the attractiveness for firms to adopt advanced technologies (thereby reducing aggregate output and productivity) and that the latter effect is strenghtened by the presence of a not competitive labour market.[5]

In this paper we analyse the effect of employment protection legislation on growth of value added and hours of work in Europe using EUKLEMS data for 51 manufacturing and service sectors for 14 countries during the period 1970-2005. In particular, we interact an indicator of EPL at the country level with a sectoral measure of human capital intensity which is invariant across countries (i.e., years of schooling in the workforce at the industry level) and is derived from US census data (as in Ciccone and Papaioannou, 2009). This methodology, first proposed by Rajan and Zingales (1998), has been proving popular among applied economists because it allows to overcome standard econometric problems of omitted variable bias and reverse causality through a difference-in-difference approach.

Our results clearly suggest that EPL has a negative effect on value added growth in more human capital intensive sectors. Our preferred estimates indicate that the growth rate differential between a sector at the 75th percentile of the human capital intensity distribution (*production of other transport equipment*) and a sector at the 25th percentile (*tobacco*) is in the range -0.5%/-0.9% in a country at the 75th percentile of the EPL distribution (Greece) with respect to a country at the 25th percentile (Austria). A similar, but slightly smaller, effect is found for growth of hours of work. We check the robustness of this result considering various different specifications. First, we examine whether our interaction between EPL and human capital intensity partly captures other interactions of EPL with industry features that might be correlated with human capital intensity, such as R&D or physical capital intensity and sectoral riskiness. Second, we consider the role of alternative determinants of industry growth by including the relevant interactions between industry and country characteristics, such as the average years of schooling at the country level and the sectoral human capital intensity, the country capital output ratio and the industry physical capital intensity, the sectoral R&D intensity and the country R&D stock. Third, we include interactions between human capital intensity and country level variables potentially correlated with EPL such as union density,

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industries with higher shares of skilled workers; in turn, Givord and Maurin (2004) find that the job loss rate is higher in sectors with a higher share of R&D and high skilled workers; finally, Borghi (2010) employs EU firm level data and reports empirical evidence showing that job turnover is stronger in high skilled industries and in sectors with higher technology intensity.

[5] Our paper is also related to recent work by Koeniger and Leonardi (2007) who analyse the effects of labour market institutions on wage inequality. In particular, in their theoretical framework, downward wage rigidities relatively favor investments in low-skill-complementary capital, thus compressing the growth of high skill intensive sectors.

strike activity, the level of financial development and the presence of entry barriers. Fourth, we consider the potential endogeneity of EPL by instrumenting it with political economy variables: to do this, we use the percentage of years of left-wing government over the sample period (Botero et al., 2004), the presence of a dictatorship spell before 1970 (Bassanini et al., 2009) and the attitude taken by governments towards the development of labour unions in the early 20^{th} century (Mueller and Philippon, 2008). Fifth, we consider the possibility that EPL may have a differential impact on growth depending on the country's distance from the technological frontier. We finally check that our main results are not driven by benchmarking bias using a two-step instrumental variable estimator recently proposed by Ciccone and Papaioannou (2010).[6] We conclude that our robustness checks confirm the baseline results.

We add to the previous literature in various directions. First, we explore the role of labour market regulations in shaping the relation between technology adoption and growth, an aspect substantially neglected so far. Moreover, by considering whether EPL disproportionately affects growth in human capital intensive industries, we offer empirical evidence on the role played by labour market institutions in driving the pattern of specialisation.[7] We argue that human capital intensity is a simple and general measure of the sectoral technology adoption propensity. The average schooling level of the workforce is in fact strictly correlated to R&D or ICT intensity, which are other natural measures of technological advances. We claim that our measure correctly captures the ability to successfully introduce recently developed technologies, as for example ICT and related technical advances, and to fully exploit their potential. Moreover, the technology adoption stage may be conceptually kept distinct from other aspects of technological change, as the production of innovation which is perhaps best captured by R&D activities: in this regard, our result that EPL slows down growth particularly in human capital intensive industries survives even after controlling for an interaction between R&D intensity and EPL. Second, by using a long period of time, we are able to capture long run effects of labour market regulation, whereas previous papers focused on short run dynamics mostly considering only the manufacturing sector during the 90s. Finally, we show that our empirical findings are robust to other possible channels through which EPL can influence growth. In this respect, on the one hand, we consider the possibility that EPL interacts with the industry natural layoff propensity, as in Bassanini et al. (2009), or the degree of riskiness, as in Bartelsman et al. (2010); while, on the other hand, we experiment with other variables that may be correlated with technology adoption such as R&D or ICT intensity.

The rest of the paper is organised as follows. In Section 2 we review the relevant literature; in Section 3 we present the data; Section 4 contains our empirical methodology, while results are discussed in Section 5; we conclude in Section 6.

2 Related Literature

Our starting point is the literature on human capital and growth; in particular, we consider the role of human capital for technology adoption and growth in the spirit of Nelson and Phelps (1966).[8] Within that framework, we follow Ciccone and Papaioannou (2009) who

[6] In fact, Ciccone and Papaioannou (2010) show that using industry data of a benchmark country as a proxy for the relevant industry characteristics (human capital intensity in our case) might lead to a significant bias in parameter estimates whose direction is not clear a priori.

[7] In this respect, our paper is strictly related to recent work by Bartelsman et al. (2010), who provide evidence of a negative effect of high firing costs on employment especially in high-risk sectors.

[8] Reviewing such literature is beyond the scope of this paper; see Krueger and Lindhal (2001) for a survey on human capital and growth. See Benhabib and Spiegel (1994) for the first empirical application of the

introduce skill biased technical change into the technology adoption model and provide robust evidence of strong human capital level and accumulation effects on growth in more human capital intensive sectors.

One implicit assumption in this literature is that technology adoption is not costly and that firms can adjust their workforce accordingly. However, in countries where labour markets are strictly regulated and employment protection legislation is pervasive, firms' adjustment costs can be particularly high: thus EPL reduces turnover of workers and consequently firm performance and overall productivity.[9]

One strand of literature in particular analyses how EPL affects growth through changes in the specialisation pattern of countries. Saint-Paul (1997) presents a model where EPL drives the comparative advantage of a country towards low-risk sectors in which innovation is more directed towards later stages in a product life cycle: as a result, countries with higher EPL tend to specialise in secondary innovation, while others tend to specialise in primary innovation (see also, Saint-Paul, 2002b).[10] Similarly, Samaniego (2006) argues that industry composition is a channel of primary importance to study the effect of EPL on growth: in sectors in which technological progress is very fast, firms have to continuously cut employment; as a result, countries with high firing costs specialise in sectors in which technical progress is slow.[11]

Along these lines, Bartelsman et al. (2010) develop a search-matching model with two sectors and different productivity shocks in which EPL reduces the share of the highly innovative sector in the economy as it makes exit more costly. By relatively reducing the attractiveness of the ICT sector, firing restrictions disproportionately increase employment in low risk sectors.[12] Related results are obtained by Poschke (2009) in an endogenous growth model in which the effect of firing costs on aggregate productivity growth is analysed through selection, reallocation and imitation. In that context, EPL is more stringent in the service sector, which uses information technologies more intensively and where firms face higher variance of productivity shocks.[13] Similarly, industry differences in volatility and labour market institutions at the country level can determine the pattern of comparative advantage; as a result, countries with more flexible labour markets tend to specialise in high volatility industries (Cuñat and Melitz, 2007).

While most of the above contributions concentrate on the effects of EPL on the specialisation pattern of countries, a related literature highlights the direct link between EPL and productivity. In this spirit, Scarpetta and Tressel (2004) offer evidence that strict EPL can have a strong negative impact on productivity because it diminishes the incentives to innovate

technology adoption model.

[9] Lazear (1990) and Nickell et al. (2005) study the effects of EPL on labour market outcomes. See Bertola (1994) and Hopenhayn and Rogerson (1993) for the aggregate effects of labour legislation on growth.

[10] Griffith and Macartney (2010) offer empirical evidence consistent with these theoretical predictions. Using a sample of multinational firms with establishments in different countries, they show that EPL can have different effects on innovation: while higher levels of EPL reduce radical innovations, incremental innovations are positively related to stricter labour regulations.

[11] Samaniego (2008) develops a model with technology adoption in which labour market rigidities interact with the rate of embodied technical progress resulting in differences in aggregate outcomes across countries with different labour market regulations.

[12] Koeniger and Prat (2007) develop a search theoretic model in which the effect of EPL on job and firm flows is jointly considered with product market regulation. Both labour and product regulation have countervailing effects on flows, suggesting that firm selection is a channel of primary importance to understand the net effect.

[13] Samaniego (2010) uses European data at firm level to study the relation between different measures of firm turnover at the country level and investment-specific technical change at the industry level, finding a positive long run relationship between them. Caballero et al. (2004) show that countries with strict firing restrictions adjust employment quite slowly; as a consequence, they suffer low productivity growth.

and adopt new technologies. Similar results are found by Bassanini et al (2009) who use EU-KLEMS productivity data at sectoral level for a set of OECD countries, and find that EPL lowers total factor productivity growth disproportionately in sectors in which the technology requires continuous adjustment in employment and where the natural layoff rate is higher.[14] Along the same lines, Micco and Pages (2007) provide evidence that more stringent labour legislation reduces job turnover in manufacturing, and that this effect is more pronounced in sectors that are intrinsically more volatile; moreover, they find that the decline in entry of firms reduces both employment and value added in the high reallocation sectors. Additional empirical results are offered by Autor et al. (2007) who show that while EPL may have a positive impact on labour productivity because firms could engage in capital deepening, EPL always has a negative effect on total factor productivity as it distorts the adoption of production techniques.[15]

Finally, in the tradition of the new Schumpeterian growth theory, some papers analyse whether EPL has a differential effect on productivity depending on the country's position relative to the technology frontier. Bartelsman et al. (2008) estimate a production function augmented with an interaction between EPL and distance from technological frontier for the period 1991-2004. They find that EPL depresses total factor productivity and the effect is stronger the closer the country is to the technology frontier. Similar results are obtained by Aghion et al (2009) who find that both product and labour market regulation may have different effects on total factor productivity growth depending on the country's position relative to the technological frontier.

3 Data

3.1 Country-Industry Level

Data for real value added and hours of work are from the public release of the EUKLEMS database (see Inklaar et al., 2008) which contains detailed information on various industry-level variables for 14 OECD countries for the period 1970-2005. We extract the available data for 51 sectors according to the ISIC Rev3.1 classification for Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, Spain, Sweden, and the United Kingdom. We drop other EU countries as data were not available for the complete covered period and the US, as the latter is used as the benchmark in our differences-in-differences approach. The industries considered in this work span from agriculture to manufacturing and market services, while we do not consider public administration and defense, community personal services, education, health and social works (see Tables 1 and 2).

[Insert Tables 1 and 2 about here]

For many countries we do not have information about all 51 sectors, but in no case the number of industries falls below 35, with most countries in the range 45-51. Overall, our sample is based on 595 (618) observations in the case of value added (hours) growth regressions.

[14] Cingano et al. (2010), use EU firm-level data and find that EPL reduces investment per worker, capital per worker and value added per worker in high reallocation sectors relative to low reallocation ones.

[15] Messina and Vallanti (2007) use firm-level data and find that economies that grow faster suffer less from firing restrictions and that the impact of EPL is differentiated across sectors within a given country.

3.2 Industry Level

Our measure of human capital intensity at the industry level is derived from the Integrated Public Use Microdata Series database which collects individual microdata from US census. To construct such a measure, we closely follow Ciccone and Papaioannou (2009). We impute average years of schooling for each educational attainment in 1970 as follows: 0 (no schooling), 1 (Grades 1-4), 6 (Grades 5-8), 10 (Grades 9-11), 12 (12 Grade), 14 (College 1-3), 17 (College 4+).[16] As the IPUMS database uses a different industry classification from the one in the EUKLEMS data, we recode sectors according to our definition.[17] Then, for each sector, we calculate the share of employees in each educational attainment level and multiply this share by the average years of schooling calculated above.[18]

We also consider another industry level variable that has been recently used to study the relationship between EPL and productivity (see above): while Micco and Pages (2007) assume that firing restrictions are more likely to be binding in sectors with high gross job turnover rates, Bassanini et al (2009) prefer instead to use an industry's layoff rate, which they argue represents a better proxy for the a priori "bindness" of firing restrictions. In order to verify whether our results are robust to controlling for the theoretical mechanism considered by Bassanini et al. (2009), we have built a proxy for each industry's specific layoff propensity, using data from the US 1994 CPS Displaced Workers Supplement.[19] In particular, as in Bassanini et al. (2009), the layoff propensity of an industry has been proxied with the fraction of workers that had been displaced in the years covered by the 1994 survey.

Other sector level variables that we consider in the paper are the physical capital, R&D, ICT and risk intensity. The first has been computed, as in Ciccone and Papaioannu (2009), as the ratio between real gross capital stock and value added in the US in 1970 using data taken from the EUKLEMS; in turn, R&D intensity is proxied by the R&D expenditure to value added ratio in the US in 1973 using data taken from the OECD ANBERD database;[20] ICT intensity was computed as the share of ICT expenditure in total investment outlays using EUKLEMS data; finally, as a proxy for risk intensity we use the standard deviation of the distribution of output growth across firms in the US, which has been made recently available for the manufacturing sector in the EUKLEMS database for the year 1992.

3.3 Country Level

The main country level variables are in Table 3. The indicator of EPL at the country level is taken from Checchi and Lucifora (2002) who originally used the one by Nickell et al (2001). Data are five years average starting from the 60s; we construct an average measure of EPL from 70-75 to 95-00 that varies from 0 (less regulated) to 2 (most regulated). One pitfall of this indicator of EPL is that there is no information for Portugal and Greece: for these two

[16] For 1990 we slightly changed the imputation method as the coding of educational attainment has also changed. We proceed as follows: 1 (Nursery-Grade 4), 6 (Grades 5-8), 10 (Grades 9-11), 12 (12 Grade), 14 (College 1-3), 17 (College 4+).

[17] The industry classification used in the IPUMS database is the Census Bureau Classification Scheme. See http://usa.ipums.org/usa/volii/97indus.shtml (accessed June 30, 2010). Details on the conversion methodology used are available upon request from the authors.

[18] Our measure of human capital intensity has a strong positive correlation (0.91) with the one used by Ciccone and Papaioannou (2009) for the manufacturing sectors in 1980.

[19] This is the oldest CPS survey on displaced workes we have been able to find. However, Bassanini et al. (2009) note that this measure is relatively stable over time.

[20] Unfortunately, we have been able to get information for R&D data only for a limited number of (mainly) manufacturing industries.

countries we therefore use data taken from the most recent release of the OECD's employment protection legislation indicators, appropriately rescaled to compare it with that of Nickell et al (2001).[21] As a robustness check, we also use, as a measure of EPL, the recent OECD indicator just mentioned: in particular, we use data on EPL in regular employment jobs for the period 1985-2008 and we construct an average measure for the period 1985-2005. The disadvantage of the OECD data is that they have information for Greece and Portugal but they do not cover the beginning of our sample period. In any case, the correlation between the two indicators is very high and equal to 0.96.

[Insert Table 3 about here]

Remaining control variables are taken from different sources. From the Barro and Lee (2001) dataset we extract different measures of schooling at the country level such as years of schooling in the population with more than 25 years in 1970 and the average growth rate of this measure over the period 1970-1999.[22] From Checchi and Lucifora (2002) we also extract measures of strike activity (number of employees participating in strikes over total number of employees), union density (number of enrolled over total employees) and the tax wedge.

Other country level controls come from conventional sources. Financial development is measured as the ratio between domestic credit to private sector and GDP and is taken from the World Bank Global Development Finance database; a measure for the rule of law has been proxied with the structure and security of property rights index reported in the Economic Freedom of the World database; trade openness is computed as the ratio between the sum of export and imports over total GDP; GDP per capita is from the most recent release (6.3) of the Penn World Tables; our measure of product market regulation is calculated as an average of entry barriers over the period of analysis taken from the OECD product market regulation database; finally, our measure of TFP is computed assuming that GDP is produced with a Cobb-Douglas technology with a labour share of one third using data from Klenow and Rodriguez-Clare (2005).

A few more words are necessary for the computation of the physical capital-output ratio. We follow Klenow and Rodriguez-Clare (1997) by computing the capital to output ratio in 1950 as $\frac{K}{Y} = \frac{I_k/Y}{g+\delta+n}$, where I_k/Y is the average investment rate in physical capital between 1950 and 1970, g and n are the average rate of growth of labour productivity and of population over the same period, respectively, and δ is the depreciation rate which is set equal to 8%. We then apply a standard perpetual inventory method to derive the capital stock (and therefore the capital output ratio) for 1970 and 1990.

The R&D stock data is obtained using data from different sources. For all countries but Greece, Belgium, Austria and Portugal we use the EUKLEMS data on the R&D stock for the market economy, which were constructed applying the perpetual inventory method to R&D expenditure data. As the EUKLEMS series start in 1980, we compute the R&D stock for previous years by applying the perpetual inventory method backwards to 1973 using OECD data on R&D expenditure from the OECD ANBERD database.[23] For Greece, Belgium, Austria and Portugal we use the OECD expenditure data and apply the perpetual inventory method forward to derive estimates of the R&D stock for 1973 and 1990.[24]

[21] All main results are robust to dropping Greece and Portugal.

[22] For the regressions that we run over selected subperiods, we always consider the value that the different variables take at the beginning of the sample period, unless otherwise stated.

[23] We apply a depreciation rate of 12%.

[24] For these countries we need a value for the R&D stock in the first year. We compute this benchmark value as $R\&DSTOCK_{1973} = R\&D_{1973}/(g+\delta)$, where δ is the depreciation rate, set at 12%, g is the average rate of

4 Estimation and Identification

Our empirical framework is similar to that of Ciccone and Papaioannu (2009) and is based on the differences-in-differences approach pioneered by Rajan and Zingales (1998) and subsequently employed in many other empirical applications. In order to evaluate whether employment protection legislation tends to reduce growth particularly in human capital intensive industries, we estimate different versions of the baseline equation (1):

$$\Delta \ln y_{s,c,1970-05} = \alpha(HCINT_{s,1970} * EPL_{c,1970-05}) + \gamma W_s^{'} Z_c + \delta \ln y_{s,c,1970} + v_s + u_c + \varepsilon_{s,c} \quad (1)$$

where the dependent variable is the average rate of growth of value added or total hours worked in country c and sector s over the period 1970-2005; v_s, u_c and $\varepsilon_{s,c}$ are sector and country specific fixed effects and a conventional error term, respectively; $HCINT_s$ is the human capital intensity of each industry; EPL is the country average degree of employment protection over the period 1970-2000. Furthermore, our regression specification takes into account other possible determinants of industry growth by including the relevant country and sector interactions $W_s^{'} Z_c$, such as the country years of schooling in 1970 (and the improvements in schooling years over the sample period) and the sector human capital intensity in 1970; the country capital-output ratio and the sectoral physical capital intensity in 1970, and the industry R&D intensity and the country R&D stock in 1973. Finally, we take into account possible convergence effects by including in all regression specifications the log of the dependent variable at the beginning of the period.

In equation (1) country dummies should pick up the effects of any omitted variable at the country level, such as the quality of institutions, macroeconomic conditions over the period, social norms, etc.; in turn, industry fixed effects may capture differences in technologies or sector specific patterns of growth. A negative sign for the coefficient α would indicate that countries with higher degrees of employment protection legislation tend to grow less in schooling intensive industries: in other words, employment protection legislation tends to slow down growth disproportionately in human capital intensive industries, and as a result high-EPL countries tend to specialise in less schooling intensive industries.

The inclusion of $W_s^{'} Z_c$ is important because there is evidence that countries with an abundant factor tend to specialise in industries that use intensively that factor (Ciccone and Papaioannou, 2009). Controlling for the relevant country-industry interactions should allow us to take into account the possibility that W_s (e.g. an industry physical capital intensity) and $HCINT_s$ or Z_c (e.g. a country capital stock, the accumulation of human capital, etc.) and EPL_c are correlated: in this case, the omission of the relevant country-industry interactions would tend to bias the OLS estimates of α. In addition to this, given that there might be other country-level variables, potentially correlated with EPL, that might interact with industry schooling intensity, as a robustness check we also include additional interactions between $HCINT$ and country level variables such as GDP per capita, financial development, the respect of property rights, the stock of R&D capital, union density and other labour market institutions.

Moreover, in order to consider the possibility that EPL might interact with some other industry characteristics, in some specifications we augment our regressions with interactions between EPL and sector level variables, such as R&D, physical capital, riskiness and layoff intensities. Furthermore, given that there might be reasons to believe that causality might go in the other direction, namely from growth to employment protection legislation (see below),

growth of R&D expenditure over the period 1973-1985 and R&D is R&D expenditure.

we also estimate a version of equation (1) in which we instrument EPL with different variables rooted in the history of each country (existence of dictatorship spells before 1970 and attitudes of the political system towards labour unions at the beginning of the 20^{th} century) and political economy variables (percentage of years with a left-wing government).[25] Finally, we check that our main results are not sensitive to the benchmarking bias highlighted by Ciccone and Papaioannu (2010).

5 Results

5.1 Basic Results

We first investigate whether human capital intensive industries grew faster in countries with less strict employment protection legislation over the period 1970-2005. In columns 1 to 3 of Table 4 we measure industry growth using value added (VAg), while in columns 4 to 6 we proxy the changes in production structure with the growth rate in total hours worked (Hg). In columns 1 and 4 we start with a parsimonious specification of equation (1), as we control only for country and sector fixed effects and for initial differences in the size of sectors (by including the log of value added or hours worked in 1970). The coefficient of the interaction between the average level of employment protection over the period 1970-2005 and human capital intensity is negative and statistically significant at the 1% level in both columns 1 and 4. In the case of value added growth, the coefficient of -0.00805 implies a yearly growth differential of 0.89% between the sector at the 75^{th}percentile (*production of other transport equipment*) and at the 25^{th} percentile (*tobacco*) of human capital intensity in a country at the 25^{th} percentile of EPL (such as Austria, with an average of 1.119 over the period) compared with a country at the 75^{th} percentile of EPL (such as Greece, with an average of 1.797).[26] If we measure industry growth using data on total hours worked, we find a slightly smaller effect, namely -0.00668, which implies a growth differential of about 0.74% between the sector at the 75^{th} and the 25^{th} percentile of schooling intensity in a country at the 25^{th} percentile of EPL compared to a country at the 75^{th} percentile of EPL.

[Insert Table 4 about here]

As shown in Ciccone and Papaioannou (2009), human capital intensive industries tend to grow faster in countries with higher initial levels of schooling, the intuition being that, if technological progress has been skilled labour augmenting over the sample period, higher levels of schooling should foster the adoption of new technologies. However, if employment protection legislation were lower in countries with more years of schooling, then the interaction term between EPL and human capital intensity might be downward biased if we do not control for years of schooling. In order to check for this possibility, in columns 2 and 5 we have included interaction terms between human capital intensity and both the years of schooling at the country level in 1970 and the country level increase in average years of schooling over the sample period. Regression results show a positive and significant coefficient for the human capital level interaction, and a positive but slightly insignificant coefficient for the accumulation term, broadly confirming the results of Ciccone and Papaioannou (2009) for a different set

[25]This variable is defined as the percentage of years of a left-wing government over the sample period and is taken from the Comparative Poltical Dataset (Armingeon et al., 2008)

[26]If we consider the two countries with the highest and the lowest levels of EPL over the 1970-2005 period, namely Portugal (2.000) and the UK (0.337), the annual growth differential could be as high as 2.1%.

of countries-industries and for a longer period of time.[27] Reassuringly, the interaction term between EPL and human capital intensity is still negative and statistically significant.

Finally, in columns 3 and 6 we drop the interaction between EPL and human capital intensity in order to compare our results with those reported by Ciccone and Papaioannou (2009) in their Table 3, column 1: in the case of the value added regression we find both a level and a growth effect of human capital, with an order of magnitude that is very similar to that implied by the estimates reported in Ciccone and Papaioannou (2009): interestingly, we find that in columns 3 and 6 the magnitude of the interaction terms between human capital intensity and both the years of schooling at the beginning of the period and its accumulation over the period go up, probably suggesting an upwards bias associated to the omission of the EPL-schooling intensity interaction.[28]

In Table 5 we try to address possible endogeneity concerns of EPL. There can be different reasons that can make EPL endogenous: for example, EPL may be simply picking up the effects of some country level omitted variables that tend to affect growth especially in human capital intensive industries (see below); alternatively, EPL and growth might be jointly determined if a country that specialises in low human capital intensity and slow growth industries is also more likely to adopt a high degree of employment protection legislation (see, for example, Saint Paul (2002a), for a theoretical model).

We use different instruments for EPL. The first, quite standard in the literature, is the percentage of years of left-wing governments over the sample period: the economic rationale of using this instrument is that the country level intensity of labour regulations has been found to depend on the political power of the left (Botero et al., 2004). For the second instrument we instead follow Bassanini et al. (2009) and we build a dummy equal to one for those countries that experienced a dictatorship spell before 1970 (excluding World War II) and zero otherwise, the intuition being that historical evidence suggests that fascist dictatorships tended to protect workers against unfair dismissals due to their paternalistic views of labour relations.

Finally, we built dummies that proxy the attitude taken by governments towards the development of labour unions in the early 20^{th} century. Using a taxonomy proposed by Crouch (1993) and recently used as an instrument for the quality of today's labour relations by Mueller and Philippon (2008), it is possible to group countries into three categories, namely political inhibitors (Italy, France, Spain, Portugal and Greece), political facilitators (Germany, Austria and The Netherlands) and political neutrals (Belgium, Denmark, Finland, Ireland, Sweden and the UK). The first group is composed by countries whose government highly oppositional stance against the development of labour unions led to highly conflicting and radical labour movements; in turn, the second category considers countries whose governments coopted labour unions into the system, which in turn led to cooperative labour unions; finally, the third category groups countries that can be considered as an intermediate case (neutral). The economic justification for using these dummies as instruments for EPL is that, in political inhibitor countries, the radical and conflicting labour unions might have pushed in the past century for legislations aimed to protect workers against unfair dismissals, unlike

[27] In the case of the value added growth regression, the coefficient of the interaction between human capital intensity and the initial level of human capital implies an annual growth differential of about 0.55% between the sector at the 75^{th} percentile and at the 25^{th} percentile of human capital intensity in a country at the 75^{th} percentile of years of schooling distribution compared with a country at the 25^{th} percentile.

[28] For robustness checks to possible outliers and influential observations we also run the specifications in Table 4 dropping, one at a time, each sector and then each country. The interaction term between human capital intensity and EPL remains negative, statistically significant and with very similar magnitudes to that reported in Table 4.

what might have happened in most facilitator or neutral countries, where agreements between labour unions and employers are more likely and therefore the necessity for unions to push for employment protection legislation might be less strong.

[Insert Table 5 about here]

In columns 1 and 5 of Table 5 we instrument the interaction of human capital intensity with EPL with the interaction of human capital intensity with the left wing government indicator and the dictatorship spell dummy. First stage results, reported in the bottom part of the Table, suggest that both variables are significant and with the expected sign: countries that experienced a dictatorship spell and that had many years of left wing governments also tend to have stronger EPL. Moreover, the Hansen J statistics rejects at the 10% level the null hypothesis that the instruments are correlated with the error term and the Kleibergen-Paap LM and F statistics do not suggest problems of underidentification or weak instruments problems.[29] Second stage results suggest that the human capital intensity-EPL interaction is always negative and statistically significant with a magnitude which is only slightly lower than that reported in Table 4 for the OLS case. In columns 2 and 6 we check the robustness of these results by instrumenting the interaction between human capital intensity and EPL with the interaction of human capital intensity with the left wing government indicator and the dummies for cooperative and neutral labour origins. First stage results suggest that countries with neutral and cooperative labour origins tend to have a lower degree of EPL, while second stage results confirm that EPL tends to significantly reduce growth particularly in human capital intensive industries.[30] In columns 3 and 7 we use the dictatorship spell dummy and the labour origin dummies as instruments for EPL and main results are broadly confirmed. Finally, in columns 4 and 8 we jointly consider all three sets of instruments: again, the human capital intensity-EPL interaction is negative and statistically significant and first stage results do not display evidence of weak identification and weak instrument problems.[31]

We then test the robustness of our main results to some of the other determinants of industry growth suggested in the literature by including the relevant country and sector interactions $W_s' Z_c$. Moreover, because human capital intensity is quite different from other sector-level intensity measures that have been previously used in the literature to analyse the effect of EPL on productivity growth, we also assess whether interacting EPL with other sector level intensity measures affects our main result that EPL tends to reduce growth disproportionately in human capital intensive industries.

First, as in Ciccone and Papaioannu (2009), in column 1 of Table 6 we include an interaction term between a country capital-output ratio and a sector physical capital intensity to take into account the possibility that, if physical and human capital intensity are correlated, then the interaction between schooling intensity and EPL might be picking up the effect of a country physical capital stock: parameter estimates show that our results are basically unchanged and the coefficient of the physical capital interaction term is not statistically significant.[32] In column 2, we interact R&D intensity with our measure of EPL. As expected, more R&D intensive sectors grow less in countries with higher level of EPL: in particular, the coefficient

[29] Underidentification and weak instruments tests are availble from the authors upon request.

[30] Again, we do not have evidence of weak instrument problems.

[31] We have also explored the use of legal origin dummies as excluded instruments (as in Bassanini et al., 2009) and our main results are virtually unaltered.

[32] We also consider the interaction between an industry R&D intensity and the R&D stock at the country level obtaining very similar results to those reported in column 1 of Table 6.

on the interaction term is negative and statistically significant at 10% level. However, the latter effect becomes insignificant when we jointly consider the role of human capital and R&D intensity in column 3; interestingly, the negative effect of the interaction of EPL with human capital intensity stands out.[33] This result may suggest that EPL slows down growth by affecting the adoption of technology rather than the production of innovation. Following Samaniego (2006), we further check this result calculating a measure of ICT intensity at sectoral level (proxied by the share of ICT in total investment spending in the US as of 1970, using data from EUKLEMS) and interacting this measure with EPL: results in columns 4 and 5 are very similar to those found in the case of R&D.

[Insert Table 6 about here]

Bartelsman et al. (2010) note that the proportion of high skilled workers in a sector is positively related to the riskiness of that sector, proxied by the observed variance of labour productivity within an industry averaged across countries. Therefore it might be important to take into account the possibility that our interaction is picking up such correlation. Hence, in column 6, we add an interaction term between our measure of sector riskiness and EPL. In particular, we use the standard deviation of the distribution of output growth across firms in the US.[34] Results indicate that although EPL tends to depress growth in risky sectors, the interaction term is not statistically significant at conventional levels; in turn, the interaction term between human capital intensity and EPL is negative and statistically significant. Similar results are obtained in column 7 when we interact EPL with a sectoral measure of layoff intensity (as in Bassanini et al, 2009), i.e., considering the negative effects of EPL on reallocation of workers. Finally, in column 8 we consider the role of physical capital intensity interacted with EPL: again, including this control doesn't affect our result.[35]

We conduct additional robustness analysis in Table 7. In columns 1 and 5 we use a measure of EPL directly available from the OECD as discussed in previous subsections. Because it has a slightly higher range of variation, coefficients are not directly comparable with those reported in previous tables: nevertheless, the main result of a negative effect of EPL on growth in human capital intensive sectors holds.[36] Then, in columns 2 to 4 we consider whether EPL is simply picking up the effect of other labour market institutions on growth. In particular, we alternatively add interaction terms between human capital intensity and union density, number of strikes and the tax wedge. The empirical estimates show that the interaction between schooling intensity and EPL is still negative and statistically significant at either 1% or 5%, and that the interactions of schooling intensity with both density and number of strikes are negative but insignificant.[37] Very similar results hold when we measure growth with hours of work.[38]

[33] Note that data availability allows us to consider R&D intensity only in the manufacturing sectors. As we show in Table 9, the effect in that macro-sector is stronger, this explains the higher magnitude of the interaction between human capital intensity and EPL.

[34] Given that our proxy for sector riskness is available only for the manufacturing sectors in 1992, the regression presented in column 6 refers to the manufacturing sectors for the period 1990-2005.

[35] Similar results are obtained when we consider hours of work; results are available upon request.

[36] We have also used the employment law index of Botero et al. (2004) and our main results are virtually unaltered.

[37] We also consider the interaction between human capital intensity and duration of unemployment benefits with very similar results.

[38] In regressions not reported, but available from the authors, we measure a country schooling level with the percentage of the population who completed secondary or tertiary education. The results confirm that higher EPL tends to affect disproportionately growth in human capital intensive industries.

[Insert Table 7 about here]

A potential criticism to using US industry data as a proxy for an industry human capital intensity might generate non-negligible bias for the human capital intensity-EPL interaction term, whose direction is not even clear a priori. In order to check the robustness of our result we therefore employ the two-step IV estimator recently suggested by Ciccone and Papaioannou (2010), to whom we refer for an in-depth discussion of the derivations.

In the first stage we estimate, for all countries but the US, the following equation with OLS :

$$\Delta \ln y_{s,c,1970-05} = v_s + u_c + \gamma_s EPL_{c,1970-05} + \varsigma_{s,c} \tag{2}$$

where γ_s are industry specific slopes and the other symbols are as in equation (1). Ciccone and Papaioannu (2010) show that the "true" human capital intensity could then be built (netting out country effects) as the predicted human capital intensity for the country with the most flexible labour market (the US), as: $\widehat{HCINT}_{s,1970} = \widehat{v}_s + \widehat{\gamma}_s EPL_{US,1970-05}$, where $EPL_{US,1970-05}$ is the value of our EPL indicator for the US. We then use $\widehat{HCINT}_{s,1970}$ as an instrument for $HCINT_{s,1970}$. Regression results are displayed as column 1 of Table 8: as we can see, the human capital intensity-EPL interaction is negative and statistically significant, with a magnitude larger than in the OLS case, suggesting the existence of attenuation bias in the OLS estimates.[39]

[Insert Table 8 about here]

In the remaining columns of Table 8 we explore in some detail the possibility that EPL is simply proxing the effects of some other country variables that tend to affect value added growth particularly in human capital intensive industries, such as the capital output ratio, the level of financial development, the respect of property rights, the per capita income level, the country stock of R&D capital, and the degree of product market regulation (proxied by the OECD indicator of entry barriers in network sectors). Our empirical findings confirm that a higher level of EPL tends to significantly reduce value added growth particularly in human capital intensive industries; furthermore, none of the additional controls turns out to be statistically significant.[40] Main results are confirmed for hours of work, which are not reported for space reasons.

5.2 Robustness

In this subsection we check whether there are important differences between the two subperiods 1970-1990 and 1990-2005 and between manufacturing and non manufacturing industries; finally, we check whether the impact of EPL changes with a country's distance from the technological frontier.

In Table 9 we start running a baseline regression for the two sub-periods 1970-1990 and 1990-2005 (columns 1-2 and 5-6 for value added and hours of work respectively). Our a priori expectation is that the effect of EPL should be stronger in the second period. This is because

[39] The first stage is an OLS regression of $HCINT_s * EPL_{c,1970-05}$ on a set of country and sector dummies, initial conditions and $\widehat{HCINT}_s * EPL_{c,1970-05}$. Both the Kleibergen-Paap LM and F statistics do not suggest problems of underidentifcation or weak instrument problems. Results obtained for hours of work are very similar.

[40] We also run regression considering the interaction between the degree of openness to trade and human capital intensity with very similar results.

there is empirical evidence (e.g., Caselli and Coleman, 2002) suggesting that the new technologies that started to be available during the 1970s have been relatively more skill biased than those prevailing before: if we take into account the adjustment costs and the time that is often required for managers to fully appreciate the potential of new technologies and to incorporate them into the companies' routines, then one may think that skilled labour augmenting technical change might have been relatively weaker in the 1970s and 1980s compared to the 1990s and early 2000s. But if this is the case, then one can also think that a more stringent employment protection legislation should have been more binding in human capital intensive industries precisely over the period 1990-2005, rather than in the previous two decades. As we can see from columns 1-2 and 5-6, both the value added and hours regressions suggest that the interaction between EPL and schooling intensity had a negative effect in both sub-periods, but also that it is statistically significant only in the most recent period, thus confirming our a priori expectations.[41]

[Insert Table 9 about here]

In columns 3-4 and 7-8 we split the sample between manufacturing and non manufacturing industries in order to examine whether there is any sector level heterogeneity in the interaction between EPL and schooling intensity. Before discussing the results we should however bear in mind that this split entails a severe degrees of freedom loss, especially in the case of the non manufacturing regression. As we can see, EPL tends to significantly reduce growth in human capital intensive industries both in the case of manufacturing and non-manufacturing sectors, although the effect is much stronger in the former case.[42]

Finally, in Table 10 we allow the interaction between schooling intensity and EPL to vary with the country's distance from the technological frontier. The intuition is that EPL is likely to be more binding for a country near the technological frontier because in that case productivity growth is more likely to arise from radical innovations rather then from innovations at the margin or simply from imitation and adoption of existing technologies (Griffith and Macartney, 2010; Saint Paul, 2002b). In the first column we run a baseline version of equation (1) with only the log of beginning of the period value added as control variable plus a triple interaction between schooling intensity, EPL and the country's distance from the technological frontier. The latter variable has been computed as the ratio between US TFP and country c TFP at the beginning of the period and therefore a higher value indicates a country far from the technology frontier. To fully saturate the model we have also included an interaction term between schooling intensity and a country's distance from the technology frontier. Empirical results show that EPL tends to disproportionately reduce growth in high schooling industries but particularly in countries that are closer to the technological frontier. In order to facilitate comparisons with results displayed, in, say, Table 4, let us consider the 25^{th} percentile of TFP Distance – which corresponds to a country with a TFP in 1970 about 11% lower than the US level – and the 75^{th} percentile of TFP Distance – which corresponds

[41] If we run similar regressions for the subperiods 1970-80 and 1980-90 we find that the interaction between human capital intensity and EPL increases in absolute value in the second period, although we can still not reject the null hypothesis that is equal to zero.

[42] We also divide our sectors into ICT (including both ICT producing and using industries) and Non-ICT, using a definition proposed by Van Ark et al. (2003) and we run separate regressions for the two groups. The idea is to verify whether human capital intensity is simply capturing the more or less extensive use of ICT. Our regression results (estimates avaiable from the authors upon request) show that in both the value added and hours regressions the interaction between human capital intensity and EPL is negative and statistically significant with a very similar magnitude across the two groups.

to a country with a TFP about 26% lower than the US level. For the "efficient country", the coefficient of Human Capital Intensity $\times$ EPL would be equal to about -0.013, statistically significant at 1%, which in turn would imply a yearly growth differential of about 0.55% between sectors at the 75^{th} and 25^{th} percentile of human capital intensity in a country at the 25^{th} percentile of EPL compared with a country at the 75^{th} percentile of EPL. In turn, for the "less efficient country", the coefficient of Human Capital Intensity $\times$ EPL would be almost halved as it would be equal to about only -0.007 (statistically significant at 1%).

[Insert Table 10 about here]

In column 2 we repeat the same exercise, but including also the interaction of human capital intensity with years of schooling in 1970 and its improvement over the 1970-2000 period. Punctual estimates are virtually unaltered, although standard errors are higher, probably reflecting a problem of multicollinearity.[43] Finally, in column 3 we repeat the same exercise but only for the period 1990-2005: again, EPL tends to have a stronger effect in countries that are closer to the technological frontier. In this case, EPL would have a disproportionately significant negative effect in human capital intensive industries only for countries with a TFP no lower than 12 % of the US level in 1990, while it would be not significantly different from zero for remaining countries.

6 Concluding Remarks

In this paper, we consider the effect of employment protection legislation on industry growth. We find that EPL tends to have disproportionately negative effects on the growth rate of value added and hours of work in more human capital intensive industries. We argue that human capital intensity reflects differences in technology adoption rates across industries and that firms in sectors in which technical change is faster have higher requirements of adjusting employment. Hence, firing costs may have a relatively stronger impact in human capital intensive sectors in which technology adoption is faster.

Our results indicate strong and statistically significant negative effects of higher levels of EPL on the growth rate of value added and hours of work in human capital intensive industries. This result is robust to a series of sensitivity checks. First, we have controlled for other determinants of industry growth by means of interactions between a country factor abundance and an industry factor intensity (e.g. industry schooling intensity and country education levels and growth; physical and R&D intensity and country capital to output ratio and R&D stock). Secondly, we have checked that EPL negatively affects growth in human capital intensive industries even when it is also interacted with physical capital intensity, R&D intensity, sectoral riskiness or layoff rates at the industry level. Moreover, we have also controlled for the possibility that EPL might be picking up the effects of other country characteristics by interacting human capital intensity with other country level variables, such as the level of financial development, the respect of property rights, the per capita income level, and the degree of product market regulation among the others. Finally, we have taken into account possible endogeneity concerns of EPL. Our preferred estimates indicate a yearly value added growth differential of 0.5-0.9% between the sector at the 75^{th}percentile and at the

[43] An F test for the joint significance of human capital intensity-EPL interaction with the triple interaction including TFP distance leads us to reject the null hypothesis that they are jointly equal to zero at the 1% level.

25^{th} percentile of human capital intensity distribution in a country at the 25^{th} percentile of EPL compared with a country at the 75^{th} percentile of EPL.

We also find that the effect of EPL on value added growth is stronger in the more recent years than during the 70s and 80s, and in the manufacturing than in the service sector; finally, we show that EPL tends to disproportionately reduce growth in high schooling industries but particularly in countries that are closer to the technological frontier. This confirms our baseline result that EPL reduces growth in the more advanced countries and dynamic sectors of the economy.

Our analysis has also some implications for the relative dynamics of productivity and GDP growth of EU countries and the US over the last 40 years. As the growth literature suggests (see, for a recent example, Crafts and Toniolo, 2008), GDP growth during the 1960s and 1970s was mainly driven by physical capital accumulation and TFP growth, resulting in an effective catching up process between most EU countries and the US. In particular, in the decades after World War II, TFP growth in Europe was mainly achieved through a more efficient use of inputs, exploitation of scale economies and the introduction of already well established technologies. In that environment, strong employment protection did not affect the scope for catching up and the existence of a highly skilled workforce was probably not a necessary condition for achieving strong TFP growth. However, with the 1980s and especially the 1990s, sustainable high rates of GDP growth had to be achieved through strong productivity growth. As Aghion and Howitt (2006) suggest, after the catching up with the technological frontier had been completed, growth rates had to be more related to direct innovations and to the adoption of recently developed new technologies (like ICT, automated machinery, etc. whose implementation requires a more skilled workforce) that are more dependent than before on experimentation, short term relationships, better selections of workers and a more flexible labour market: as a result, more stringent EPL might have had a more detrimental impact on growth in the last two decades.

In order to provide some empirical evidence to back this conjecture, in Figure 1 we plot the difference in average TFP growth (taken from Klenow and Rodriguez-Clare, 2005) for the two decades after and before 1980 against average EPL during the observation period. The strong and significant negative correlation (which may be observed also for labour productivity and GDP) suggests that countries with higher levels of EPL are those that experienced a slow-down in their growth rates during the most recent decades. Although purely suggestive, such evidence provides additional empirical support for our thesis that labour market institutions such as employment protection legislation, by altering the incentives to adopt and exploit the full potential of new technologies, might be an important channel to understand differences in relative long run growth dynamics.

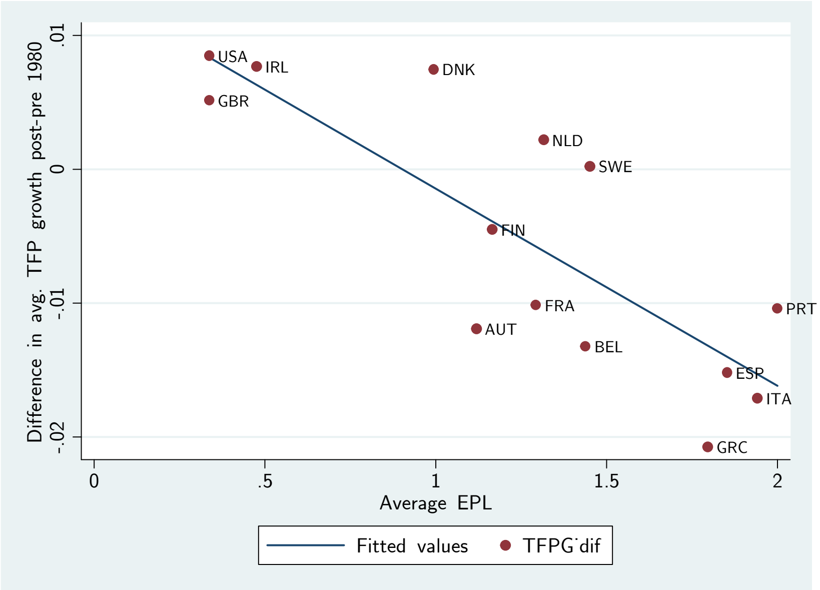

Figure 1: Changes in TFP growth post-pre 1980 versus EPL

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Table 1: Descriptive Statistics, Main Sector Level Variables

Sector	Value Added Growth	Hours of Work Growth	Human Capital Intensity	Physical Capital Intensity	Displacement Intensity	R&D Intensity
Computer and related activities	0.0725	0.0617	14.3614	0.2654	0.1466	.
Electrical machinery and apparatus	0.0328	-0.0094	12.4389	3.3791	0.1108	0.1154
Other business activities	0.0389	0.0405	13.6339	0.2654	0.1308	.
Radio, television and communication	0.0697	-0.0096	12.5150	3.3791	0.1209	0.3225
Renting of machinery and equipment	0.0488	0.0374	10.7804	0.2654	0.1101	.
Research and development	0.0394	0.0339	14.4197	0.2654	0.0840	.
Textiles	-0.0115	-0.0390	10.5165	1.4301	0.0956	0.0026
Wearing Apparel, Dressing	-0.0225	-0.0532	10.5816	1.4301	0.1233	0.0026
Activities related to financial	0.0380	0.0383	14.1775	0.1029	0.0725	.
Agriculture	0.0166	-0.0300	10.6672	5.5045	0.0628	.
Basic metals	0.0230	-0.0192	11.4270	1.2359	0.0924	0.0145
Chemicals and chemical products	0.0451	-0.0075	12.9635	0.9268	0.0722	0.0724
Coke, refined petroleum and nuclear	0.0135	-0.0154	13.1708	16.4665	0.1010	0.0883
Extraction of crude petroleum	-0.0257	0.0041	12.8607	4.8681	0.1454	.
Fabricated metal	0.0197	-0.0040	11.8440	1.2359	0.1283	0.5930
Financial intermediation	0.0436	0.0147	13.0936	0.1029	0.0963	.
Food and beverages	0.0186	-0.0101	11.3830	1.1122	0.1121	0.0093
Forestry	0.0058	-0.0232	13.0160	5.5045	0.0556	.
Insurance and pension funding	0.0274	0.0133	13.4812	0.1029	0.0827	.
Leather, leather and footwear	-0.0197	-0.0451	10.5209	1.4301	0.1236	0.0026
Manufacturing nec	0.0086	-0.0085	11.5205	1.0505	0.1008	0.0123
Medical, precision and optical instr.	0.0448	0.0005	12.6221	3.3791	0.1209	.
Mining of coal and lignite;	-0.0028	-0.0618	10.0537	4.8681	0.1972	.
Mining of metal ores	0.0220	-0.0481	11.8701	4.8681	0.0577	.
Mining of uranium and thorium	0.0648	.	11.8701	4.8681	0.0577	.
Motor vehicles and trailers	0.0240	-0.0063	11.6078	0.8246	0.0957	0.1363
Total	0.0264	-0.0029	12.0038	2.6889	0.1017	0.0822

Table 2: Descriptive Statistics, Main Sector Level Variables (Continued)

Sector	Value Added Growth	Hours of Work Growth	Human Capital Intensity	Physical Capital Intensity	Displacement Intensity	R&D Intensity
Office, accounting and computing	0.0651	-0.0066	13.4828	3.3791	0.1359	0.3457
Other Air transport	0.0250	0.0025	13.0511	4.0836	0.1059	.
Other Inland transport	0.0248	0.0016	11.1633	4.0836	0.1037	.
Other Supporting and auxiliary	0.0381	0.0162	12.0696	4.0836	0.1196	.
Other Water transport	0.0328	-0.0165	11.4016	4.0836	0.1262	.
Other mining and quarrying	0.0115	-0.0159	10.8800	4.8681	0.1091	.
Other transport equipment	0.0144	-0.0151	12.8481	0.8246	0.1162	0.0039
Printing, publishing and reproduction	0.0229	-0.0052	12.2466	0.8219	0.0939	0.0061
Pulp, paper and paper	0.0211	-0.0148	11.7346	0.8219	0.0597	0.0061
Real estate activities	0.0298	0.0250	12.7502	10.6710	0.0923	.
Recycling	0.0510	0.0029	10.5165	1.0505	0.1186	.
Rubber and plastics	0.0385	-0.0011	11.7338	1.6967	0.1022	0.0424
Tobacco	-0.0000	-0.0371	11.2078	1.1122	0.0323	0.0093
Fishing	0.0010	-0.0210	10.6882	5.5045	0.1186	.
Machinery, Nec	0.0225	-0.0072	11.8739	0.3795	0.1192	.
Other Non Metallic Minerals	0.0156	-0.0152	11.4112	1.4345	0.0847	0.0170
Post and Telecommunications	0.0587	0.0028	12.4829	4.5811	0.0637	.
Retail trade, except of motor vehicles	0.0253	0.0036	11.8743	1.1944	0.0984	.
Sale, maintenance and repair	0.0199	0.0046	11.6058	2.9618	0.0931	.
Wood and cork	0.0220	-0.0098	10.6958	0.8073	0.1170	0.0067
Wholesale trade and commission	0.0298	0.0077	12.4332	0.7629	0.1009	.
Construction	0.0109	-0.0012	11.2646	0.2744	0.1524	.
Electricity and Gas	0.0376	-0.0065	12.4723	3.6751	0.0519	0.0000
Hotels and Restaurants	0.0156	0.0127	11.0701	1.1696	0.1057	.
Water Supply	0.0156	0.0057	11.8394	3.6751	0.0672	0.0000
Total	0.0264	-0.0029	12.0038	2.6889	0.1017	0.0822

Table 3: Descriptive Statistics, Main Country Level Variables

Country	Value Added Growth	Hours Growth	Average EPL	Schooling Levels	Schooling Growth	Capital Output Ratio	Union Density	Strike Activity	Tax Wedge
Austria	0.04	-0.00	1.12	7.01	0.06	1.87	0.49	0.01	0.58
Belgium	0.02	-0.01	1.44	8.40	0.01	2.06	0.51	0.01	0.47
Denmark	0.01	-0.01	0.99	8.78	0.05	1.95	0.74	0.04	0.58
Finland	0.03	-0.00	1.17	6.50	0.13	2.11	0.70	0.15	0.59
France	0.02	-0.01	1.29	5.86	0.09	1.80	0.15	0.06	0.64
Germany	0.01	-0.01	1.56	8.27	0.05	2.20	0.33	0.01	0.50
Greece	0.03	0.01	1.80	5.18	0.11	1.81	.	.	.
Ireland	0.05	0.01	0.48	6.52	0.09	1.20	0.59	0.04	0.37
Italy	0.02	0.01	1.94	5.22	0.06	2.06	0.43	0.40	0.60
Netherlands	0.03	-0.00	1.32	7.59	0.06	2.01	0.29	0.01	0.52
Portugal	0.03	0.00	2.00	2.44	0.09	1.30	.	.	.
Spain	0.03	0.00	1.85	4.68	0.09	1.66	.	0.22	0.38
Sweden	0.03	-0.00	1.45	7.47	0.13	1.96	0.80	0.02	0.73
United Kingdom	0.02	-0.01	0.34	7.66	0.06	1.64	0.47	0.04	0.47
Total	0.03	-0.00	1.34	6.54	0.08	1.83	0.50	0.08	0.54

Table 4: Baseline Model

	(1) VAg	(2) VAg	(3) VAg	(4) Hg	(5) Hg	(6) Hg
Human Capital Intensity ×	-0.00805***	-0.00618***		-0.00668***	-0.00507***	
Employment Protection	(0.0016)	(0.0018)		(0.0012)	(0.0013)	
Human Capital Intensity ×		0.00138**	0.00248***		0.000996**	0.00192***
Education Level		(0.00070)	(0.00062)		(0.00047)	(0.00042)
Human Capital Intensity ×		0.0402	0.0500*		0.00843	0.0153
Education Accumulation		(0.027)	(0.027)		(0.020)	(0.020)
Initial Conditions	-0.0139***	-0.0141***	-0.0140***	-0.00938***	-0.00974***	-0.00974***
	(0.0015)	(0.0015)	(0.0015)	(0.0011)	(0.0012)	(0.0012)
Observations	595	595	595	618	618	618
R^2	0.62	0.63	0.62	0.81	0.81	0.80

Robust standard errors in parentheses; *** $p<0.01$, ** $p<0.05$, * $p<0.1$. All regressions include country and sector fixed effects.

Table 5: Endogeneity of Employment Protection, IV Regressions

	(1) VAg	(2) VAg	(3) VAg	(4) VAg	(5) Hg	(6) Hg	(7) Hg	(8) Hg
Human Capital Intensity × Employment Protection	-0.00644**	-0.00498*	-0.00719***	-0.00626**	-0.00576***	-0.00398*	-0.00588***	-0.00535***
	(0.0027)	(0.0029)	(0.0026)	(0.0025)	(0.0020)	(0.0023)	(0.0020)	(0.0019)
Initial Conditions	-0.0141***	-0.0140***	-0.0141***	-0.0141***	-0.00974***	-0.00974***	-0.00974***	-0.00974***
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
Observations	595	595	595	595	618	618	618	618
R^2	0.30	0.30	0.30	0.30	0.23	0.23	0.23	0.24
First Stage Regressions								
Human Capital Intensity × Years Left Government	0.0114***	0.0114***		0.00952***	0.0107***	0.0111***		0.00855***
	(0.0015)	(0.0017)		(0.0015)	(0.0015)	(0.0015)		(0.0014)
Human Capital Intensity × Dictatorship Spell	0.561***		0.498***	0.432***	0.544***		0.523***	0.445***
	(0.041)		(0.033)	(0.039)	(0.034)		(0.029)	(0.029)
Human Capital Intensity × Neutral Labour Origins		-0.639***	-0.535***	-0.358***		-0.578***	-0.507***	-0.376***
		(0.10)	(0.079)	(0.067)		(0.088)	(0.070)	(0.061)
Human Capital Intensity × Cooperative Labour Origins		-0.297***	-0.331***	-0.196***		-0.332***	-0.292***	-0.217***
		(0.11)	(0.061)	(0.054)		(0.087)	(0.053)	(0.049)
Hansen J Statistic (p value)	0.2702	0.6437	0.4353	0.4738	0.1716	0.7876	0.5804	0.5367

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All regressions include country and sector fixed effects and interactions between human capital intensity and schooling levels and accumulation.

Table 6: Different Sectoral Characteristics; Value Added Growth

	(1) VAg	(2) VAg	(3) VAg	(4) VAg	(5) VAg	(6) VAg	(7) VAg	(8) VAg
Human Capital Intensity ×	-0.00803***		-0.0170***		-0.00786***	-0.03011***	-0.00814***	-0.00795***
Employment Protection	(0.0016)		(0.0039)		(0.0016)	(0.0103)	(0.0016)	(0.0016)
Physical Capital Intensity ×	-0.000674							
Capital Output Ratio	(0.0013)							
R&D Intensity ×		-0.0448*	-0.0100					
Employment Protection		(0.023)	(0.017)					
ICT Intensity ×				-0.000402**	-0.000155			
Employment Protection				(0.00018)	(0.00015)			
Riskiness Intensity ×						-0.05008		
Employment Protection						(0.0577)		
Layoff Intensity ×							-0.0423	
Employment Protection							(0.062)	
Physical Capital Intensity ×								-0.000699
Employment Protection								(0.00081)
Initial Conditions	-0.0139***	-0.0148***	-0.0155***	-0.0136***	-0.0140***	-0.0133**	-0.0139***	-0.0139***
	(0.0015)	(0.0025)	(0.0024)	(0.0015)	(0.0015)	(0.0055)	(0.0015)	(0.0015)
Observations	595	266	266	595	595	246	595	595
R^2	0.62	0.61	0.64	0.61	0.62	0.44	0.62	0.63

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All regressions include country and sector fixed effects.

Table 7: Different Measures of EPL and Other Labour Market Institutions

	(1) VAg	(2) VAg	(3) VAg	(4) VAg	(5) Hg	(6) Hg	(7) Hg	(8) Hg
Human Capital Intensity ×	-0.00408***	-0.00613***	-0.00476**	-0.00633***	-0.00351***	-0.00369**	-0.00371***	-0.00505***
Employment Protection	(0.00092)	(0.0018)	(0.0019)	(0.0020)	(0.00068)	(0.0014)	(0.0013)	(0.0014)
Human Capital Intensity ×		0.00263**	0.000563	0.00182		0.00100	0.000756	0.000606
Education Level		(0.0012)	(0.0014)	(0.0012)		(0.00084)	(0.00088)	(0.00070)
Human Capital Intensity ×		0.0783**	0.0450	0.0485		0.0234	0.0181	0.000241
Education Accumulation		(0.039)	(0.031)	(0.040)		(0.023)	(0.023)	(0.029)
Human Capital Intensity ×		-0.00598				-0.00140		
Union Density		(0.0075)				(0.0049)		
Human Capital Intensity ×			-0.0230				-0.00637	
Strike Activity			(0.015)				(0.010)	
Human Capital Intensity ×				0.00429				0.0103
Tax Wedge				(0.013)				(0.0083)
Initial Conditions	-0.0139***	-0.0151***	-0.0154***	-0.0153***	-0.00929***	-0.0112***	-0.0115***	-0.0116***
	(0.0015)	(0.0017)	(0.0016)	(0.0016)	(0.0011)	(0.0015)	(0.0014)	(0.0014)
Observations	595	461	511	511	618	484	533	533
R^2	0.62	0.68	0.67	0.67	0.80	0.84	0.84	0.84

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All regressions include country and sector fixed effects.

Table 8: Interactions Between Human Capital Intensity and Country Level Variables; Value Added Growth

	(1) VAg	(2) VAg	(3) VAg	(4) VAg	(5) VAg	(6) VAg	(7) VAg
Human Capital Intensity × Employment Protection	-0.0194***	-0.00591***	-0.00715***	-0.00431**	-0.00662***	-0.00613***	-0.00607**
	(0.0033)	(0.0021)	(0.0023)	(0.0020)	(0.0023)	(0.0020)	(0.0024)
Human Capital Intensity × Education Level		0.00151*	0.00123*	0.00124*	0.00101	0.00136*	0.00134*
		(0.00084)	(0.00072)	(0.00071)	(0.0015)	(0.00073)	(0.00077)
Human Capital Intensity × Education Accumulation		0.0434	0.0340	0.0776**	0.0366	0.0451	0.0392
		(0.029)	(0.029)	(0.034)	(0.030)	(0.028)	(0.029)
Human Capital Intensity × Capital Output Ratio		-0.000954					
		(0.0027)					
Human Capital Intensity × Financial Development			0.0000488				
			(0.000063)				
Human Capital Intensity × Rule of Law				0.00239			
				(0.0017)			
Human Capital Intensity × Income Level					0.000000219		
					(0.00000079)		
Human Capital Intensity × R&D Stock						0.0000000248	
						(0.000000041)	
Human Capital Intensity × Entry Barriers							-0.000201
							(0.0021)
Initial Conditions	-0.0145***	-0.0141***	-0.0141***	-0.0141***	-0.0141***	-0.0145***	-0.0141***
	(0.0014)	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0016)	(0.0015)
Observations	595	595	595	595	595	553	595
R^2	0.23	0.63	0.63	0.63	0.63	0.62	0.63

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All regressions include country and sector fixed effects.

Table 9: Different Periods and Sectors

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	VAg70_90	VAg90_05	VAg Manufact.	VAg Non Manuf.	Hg70_90	Hg90_05	Hg Manufact.	Hg Non Manuf.
Human Capital Intensity ×	-0.000177	-0.0209***	-0.0106***	-0.00448**	-0.000219	-0.0171***	-0.00491**	-0.00379***
Employment Protection	(0.0021)	(0.0052)	(0.0036)	(0.0019)	(0.0015)	(0.0049)	(0.0023)	(0.0014)
Human Capital Intensity ×	0.00338***	0.000661	0.00322**	0.000317	0.00241***	-0.00165	0.00210**	0.000468
Education Level	(0.00093)	(0.0023)	(0.0014)	(0.00067)	(0.00063)	(0.0016)	(0.00086)	(0.00050)
Human Capital Intensity ×	0.0660**	0.0289	0.135**	-0.0133	0.0445**	0.00516	0.0537	-0.0248
Education Accumulation	(0.027)	(0.056)	(0.062)	(0.027)	(0.020)	(0.033)	(0.034)	(0.026)
Initial Conditions	-0.0164***	-0.0137***	-0.0138***	-0.0153***	-0.0127***	-0.00882***	-0.00682***	-0.0144***
	(0.0017)	(0.0031)	(0.0020)	(0.0021)	(0.0014)	(0.0023)	(0.0013)	(0.0021)
Observations	513	546	310	285	535	535	323	295
R^2	0.63	0.46	0.64	0.70	0.79	0.72	0.68	0.83

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All regressions include country and sector fixed effects.

Table 10: Distance to Frontier

	(1) VAg	(2) VAg	(3) VAg90_05	(4) Hg	(5) Hg	(6) Hg90_05
Human Capital Intensity × Employment Protection	-0.0572*	-0.0447	-0.189**	-0.0172	0.00709	-0.0944*
	(0.034)	(0.042)	(0.077)	(0.021)	(0.026)	(0.049)
Human Capital Intensity × TFP Distance	-0.0571	-0.0463	-0.244**	-0.0228	0.00234	-0.100
	(0.043)	(0.052)	(0.099)	(0.027)	(0.031)	(0.061)
Human Capital Intensity × Employment Protection × TFP Distance	0.0396	0.0299	0.160**	0.00763	-0.0106	0.0738*
	(0.027)	(0.033)	(0.072)	(0.017)	(0.021)	(0.045)
Human Capital Intensity × Education Level		0.000712	0.00219		0.00113*	-0.00178
		(0.00092)	(0.0043)		(0.00061)	(0.0029)
Human Capital Intensity × Education Accumulation		0.0399	0.000669		0.0171	-0.0133
		(0.028)	(0.061)		(0.020)	(0.035)
Initial Conditions	-0.0136***	-0.0137***	-0.0137***	-0.00987***	-0.0101***	-0.00883***
	(0.0016)	(0.0016)	(0.0032)	(0.0013)	(0.0013)	(0.0023)
Observations	548	548	546	583	583	535
R^2	0.61	0.61	0.47	0.80	0.81	0.72

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1. All regressions include country and sector fixed effects.

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